

## BRIEFER ARTICLES.

### THE TREE OPUNTIAS OF THE UNITED STATES.

THREE species and two varieties of the cylindrical opuntias of the United States may very properly be termed trees. The species and varieties here designated are *O. fulgida* Engelm., *O. fulgida mammillata* (Schott) Coult., *O. versicolor* Engelm., *O. spinosior* (Engelm.),<sup>1</sup> and *O. spinosior neomexicana*, var. nov.<sup>2</sup>

*O. fulgida* is a well-marked species with characters constant and well defined. There is little danger of mistaking this species for others when it is once known. The specific characters of *O. fulgida* are substantially as given by Dr. Engelmann.<sup>3</sup> Although this species has been found as far north as southern Nevada,<sup>4</sup> within the borders of the United States it is confined almost entirely to Arizona, south of the Colorado plateau.<sup>5</sup> It is a plant of the plains and evidently reaches its greatest development on the mesas about Tucson, at an elevation of

✓<sup>1</sup> *Opuntia spinosior* (Engelm.) (*O. Whipplei spinosior* Engelm. Syn. Cact. 307. 1856).—A small tree 25 to 35<sup>dm</sup> high, trunk 12 to 25<sup>cm</sup> in diameter, with dark brown, thick, rough bark, with numerous very spiny verticillate branches forming a spreading top: joints cylindrical, varying in color from green to purple, ultimate ones 5 to 20<sup>cm</sup> long, about 2<sup>cm</sup> in diameter, the short, broad, prominent tubercles slightly crested, elevated 3 to 6<sup>mm</sup> and from 8 to 14<sup>mm</sup> long: pulvini oval, with short, light colored wool and a few short light-brown bristles at upper margin: spines 5 to 15 on ultimate joints, 30 to 50 on older joints, 5 to 15<sup>mm</sup> long, the interior ones occasionally longer, closely sheathed, reddish-brown, the sheaths white and glistening: the flower purple, 5 to 7<sup>cm</sup> broad, with broad obovate petals: fruit in whorls at extremity of branches, oval rarely globose or hemispherical, 3.5<sup>cm</sup> long and 2.5<sup>cm</sup> in diameter, bearing about 25 tubercles, unarmed, fleshy, with acid flavor, yellow: seeds regular, smooth, 4<sup>mm</sup> broad, with linear commissure.

✓<sup>2</sup> *OPUNTIA SPINOSIOR neomexicana*, var. nov.—Growing with and of the same size as the species: tubercles longer: spines more numerous and looser sheathed: flowers yellow to red, with petals much narrower and fewer than in the species: fruit longer and frequently tinted with red.

<sup>3</sup> Cactaceæ Mex. Bound. 57.

<sup>4</sup> Contributions from U. S. National Herbarium 3:448.

<sup>5</sup> Garden and Forest 8:324.

from 2000 to 3000 feet. Here an occasional specimen is found with trunk twelve inches in diameter three feet above the ground, and bearing a well formed top with wide spreading branches.

The bark of the trunk and larger limbs is thick, rough, and entirely destitute of spines, the spines falling away with the outer layers when the branches are about four inches in diameter. It varies in color from almost black to yellowish brown, depending upon its thickness and age. The terminal joints are very succulent and almost devoid of woody tissue. They are easily detached and usually develop roots after falling to the ground, establishing themselves as independent plants.<sup>6</sup> The tubercles on a joint of the first season's growth bear from five to fifteen loose-sheathed spines, but in common with many other species of cylindrical opuntias, several spines develop at the upper margin of each pulvinus during the season's growth, so that a tubercle on a stem several years old may bear as many as forty or even sixty well developed spines.

In Dr. Engelmann's description and in the account of this plant as given by most writers the flowers are said to be purple. They are however, purple only when dried or withered. In fresh condition they are bright pink. The plant of Lower California referred to this species is said by Mrs. Brandegee to have yellow flowers.<sup>7</sup> When fully open the short petals are strongly reflexed. In Arizona this plant does not bloom until July, and from this time flowers may be found until late in September. The early flowers develop from the tubercles at the ends of the joints of the previous year's growth, while the later ones grow from the terminal tubercles on the immature fruit. This process may go on through six or seven series during the months of July, August, and September until the proliferous fruit hangs from the stems in pendulous clusters, sometimes as many as seven fruits in a single cluster, one growing from the other in continuous succession.

Occasionally a fruit will remain attached to the plant for the second year, and flowers develop from the tubercles of the old fruit. In a few instances I have found a branch growing from a tubercle on a normal fruit. If a fruit not fully ripe be placed on moist sand, roots will grow from the lower tubercles and either flowers or branches from the upper ones, forming an independent plant without the growth of the seeds within. Fruits attached directly to the stems are usually larger and

<sup>6</sup> Vegetal dissemination in *Opuntia*, BOT. GAZ. 20 : 356.

<sup>7</sup> Notes on *Cactææ*, *Erythea* 5 : 122.

contain perfect seeds, while the secondary ones are generally sterile; however, an entire cluster may sometimes be found with perfect seeds.

Cattle feed upon the succulent spineless fruits, but in doing so the burr-like terminal joints frequently become detached and adhere to their heads, the innumerable barbed spines piercing the flesh and causing injurious wounds if not removed. Many small bristles cover the pulvini of the fruit at maturity and accumulating in the stomachs of the cattle feeding upon them produce large phyto-bezoars. In color the fruit at maturity is pale green, a little lighter shade than the epidermis of the stem or immature fruit.

The plant illustrated in *Garden and Forest* 8:325 was removed some eighteen months ago from the mesa to the cactus garden of the University. Although the plant is one of the largest specimens in this vicinity and at least one hundred years old, it did not seem to suffer from transplanting. In this specimen the entire root system, with the exception of a few long surface roots, was a mass of short fibers springing directly from the trunk a few inches below the surface of the soil, none reaching to a greater depth than two and one-half feet.

What has been said of *O. fulgida* applies almost equally as well to *O. fulgida mammillata*. The differences seem to be in that the variety has thicker, shorter joints; fewer, shorter spines; more prominent, shorter tubercles; and is a plant of the foothills instead of the open mesa.<sup>8</sup> The description as given by Dr. Coulter<sup>9</sup> gives the variety as more tree-like than the species. In my observations the reverse is true. Although the spines on the terminal joints are usually four to six, older ones may have twenty or thirty to the tubercle. The flowers and fruits are practically identical.

*O. versicolor* Engelm. is the most abundant cylindrical opuntia on the foothills and low mountains of southern Arizona. It is a small tree with trunk eight inches in diameter in well developed specimens, and bearing many irregular branches with terminal joints sometimes two feet in length. It has smooth, light-brown bark, without spines on the trunk and older limbs. The epidermis of the younger branches is dark-green to purple. The terminal joints are intermediate in diameter between *O. spinosior* and *O. tetracantha*, while rather prominent tubercles are intermediate in length between *O. arborescens* and *O. spinosior*.

<sup>8</sup> Garden and Forest 8:324.

<sup>9</sup> Contributions from the U. S. National Herbarium 3:449.

The short, brownish spines have inconspicuous sheaths and vary in number from four to fourteen on young joints, while on older stems there may be as many as twenty-five to a single tubercle. The flowers appear in May, expanding to nearly an inch and a half in diameter, the comparatively narrow petals varying in color from greenish-red to greenish-yellow.

The fruit ripens from December to February, usually withering and drying on the tree. Sometimes it does not dry but remains fleshy, adhering to the branches until late the next summer or in some instances for longer than two years. At maturity it frequently splits open, showing the many angular seeds within. It is not unusual for fruits that remain to become proliferous the second season. It varies remarkably in size and shape, but is usually pear-shaped and from one to two inches in length. A form of this plant growing on the foothills of the Santa Catalina mountains bears fruit less than three-fourths of an inch in diameter and almost perfectly spherical. The color of the mature fruit is the same as that of the stems, never yellow as in related species. The pulvini are all toward the apex of the fruit, and usually growing from them are one to three reflexed, persistent spines a half inch or less in length. In many specimens, however, the fruit is spineless. The seeds are irregular and angular, a character common to species with dry fruits.

Considerable confusion exists regarding the geographical distribution and specific characters which separate *O. Whipplei* Engelm., *O. arborescens* Engelm., and *O. spinosior* (Engelm.), the latter an intermediate species heretofore considered as a variety of *O. Whipplei*. *O. Whipplei* is a species of the Colorado plateau,<sup>10</sup> growing at an elevation of from 5000 to 7000 feet. As I understand this species I have never found it growing south of this plateau. In Dr. Engelmann's account of this plant,<sup>11</sup> under the brief description of the variety we are referred for illustration to *pl. 17, figs. 1-4*. Turning to this plate the figures indicated are marked *O. Whipplei*. The illustration is an excellent representation of the plant of the Colorado plateau and unquestionably represents the species instead of the variety. In the description of the species we are referred to *pl. 17, figs. 5-6* and *pl. 17, fig. 4*. Turning to these plates we find the figures marked *O. arborescens*. Here again there is confusion, but by comparing the plant of southern Arizona with these illustrations I conclude that they were made after

<sup>10</sup> Garden and Forest 9: 2.

<sup>11</sup> Pacific R. R. Report 4: 51.

material collected here and really represent what has been known as *O. Whipplei spinosior* Engelm.

*O. Whipplei* is a low, spreading bush, never arborescent and rarely more than two or three feet in height. The joints are usually somewhat clavate, and the spines are covered with white, glistening, loose sheaths, which gives the plant a characteristic appearance and readily separates it from related species. The flowers are not red as stated by Dr. Engelmann and followed by Dr. Coulter in his preliminary revision, but a yellowish-green, and when fully expanded barely an inch in diameter. From the original account of the species and variety I infer the description of the flower was drawn from material collected by A. Schott south of the Gila river, and represents the plant designated as the variety *spinosior*, which has much larger purple flowers. The fruit of *O. Whipplei* is hemispherical and less than an inch in diameter. It ripens during the winter months and usually shrivels and dries on the plant.

*O. spinosior* is not only specifically distinct from *O. Whipplei*, but has a well marked variety in southern Arizona, viz., *O. spinosior neomexicana*. This southern species and variety are low growing trees with spreading tops. By most writers the species has been confused with *O. arborescens*. In my account of *O. arborescens*<sup>12</sup> the plant illustrated is really *O. spinosior*, while the form with smaller flowers having fewer and narrower petals varying in color from red to yellow is the above variety.

The flowers and fruit of *O. spinosior* are practically the same as in *O. arborescens*, but the two species are readily separated by the long, high crested tubercles of *O. arborescens* when compared with the short almost mammillate ones of the former species. The latter species is a much smaller and more eastern plant, never approaching a tree in size, at least in the United States. I have measured specimens of *O. spinosior* in the vicinity of Tucson with trunk two feet from the ground a little over nine inches in diameter. The plant grows with *O. fulgida* on the open mesa, seldom reaching the foothills, where its place is taken by *O. versicolor*. The trunk and larger limbs are spineless, but are covered with thick, rough, dark-brown bark in elongated ridges. The flowers appear in April and May, and the fleshy fruit ripens during the following winter and spring. The large, conspicuous, deep-purple or magenta flowers, like all other species of this section known to me,

<sup>12</sup> Garden and Forest 9 : 2.

have sensitive stamens, which, when disturbed close tightly around the style a few lines below the stigma.

An average fruit has from twenty to thirty tubercles, at first armed with a number of slender spines, which are deciduous in November and December, when the fruit begins to turn yellow.

The tubercles of the immature fruit are very prominent, but as the fruit ripens it increases considerably in size, becoming more succulent and as a result the tubercles become much less conspicuous, sometimes entirely disappearing, leaving the fruit smooth save for the small bristle covered pulvini. The oval fruit when ripe is frequently two inches long, and one and one-half inches in diameter, well filled with smooth seeds similar to those in *O. arborescens*. As with *O. versicolor* the fruit occasionally remains green for the second year and becomes prolific. It is clustered at the extremity of the stems of the previous year's growth, and when ripe the verticillate branches are pendulous from its weight.

The variety grows with the species, and its general form and habit of growth is somewhat similar.—J. W. TOUMEY, *University of Arizona*.

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## WINTER CHARACTERS OF CERTAIN SPORANGIA.<sup>1</sup>

(WITH PLATE XI)

THE gross characters of winter buds have been studied for a long time, but the histological characters of the sporangia have received comparatively little attention. It is an unfortunate fact that many otherwise excellent morphological papers are marred by incompleteness, and perhaps this is nowhere more apparent than in the case of those sporangia which attain some degree of development before the winter sets in, pass the cold season in a quiescent state, and resume development in the spring. It is hoped that the description of a somewhat miscellaneous collection of sporangia will not only show in what condition many buds pass the winter, but will incidentally enable students to make their series complete without waiting until the next year to fill in the gaps. The study of these dormant sporangia may also throw some light upon the significance of the resting stages of nuclei and cells. All the material upon which the following observations

<sup>1</sup> Contributions from the Hull Botanical Laboratory. VIII.